Barriers and motivators of physical activity participation in middle-aged and older-adults – a systematic review

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Abstract

Identifying the difference in barriers and motivators between middle-age and older adults could contribute toward the development of age-specific health promotion interventions. The aim of this review was to synthesize the literature on barriers and motivators for physical activity in middle-aged (50-64 years) and older adults (65-70 years). The review examined qualitative and quantitative studies using the theoretical domain framework as the guiding theory. The search generated 9400 results from seven databases. A total of fifty-five articles meeting the inclusion criteria. Results indicate that barriers are comparable across the two age groups with environmental factors and resources being the most commonly identified barriers. In older adults, social influences, reinforcement and assistance in managing change were the most identified motivators. Middle-aged identified goals settings, believe that activity will be beneficial and social influences were most important. Findings can be used by professionals to encourage engagement with and adherence to physical activity.

Keywords: aging, exercise, theoretical domain framework

Physical inactivity is responsible for morbidity, premature mortality and substantial economic burden in which the cost was estimated to be 0·64% of global health expenditure in 2013 (Ding et al., 2016). An appropriate level of physical activity (PA) can prevent chronic diseases (Booth, Roberts, & Laye, 2012) but the proportion of older adults is increasing with older adults tending to be less physically active than younger age groups (Sun, Norman, & While, 2013). PA happens differently throughout the day during work, travel and leisure time. Its nature may be structured such as during sport or strength training; or unstructured such as whilst doing household chores. Determinants of PA differ depending on the type of activity (Koeneman, Verheijden, Chinapaw, & Hopman-Rock, 2011).

Previous systematic reviews have identified the barriers and motivators towards physical activity or exercise participation among adults (30-64 years), older adults (60+ years) or the older old (80 years and above) (Allender, Cowburn, & Foster, 2006; Baert, Gorus, Mets, Geerts, & Bautmans, 2011; Burton et al., 2017; Franco et al., 2015). The most recent review by Burton et al. (2017) highlighted barriers and motivators specific to resistance training. Most of the barriers and motivators identified were similar to PA in general, with some being specific to resistance training. Another systematic review which examined barriers and motivators and included all age groups was limited to studies carried out in the United Kingdom (UK) (Allender et al., 2006). The other two reviews did not explore differences between middle-aged and young-old, which the current review aims to achieve to address the gap.

PA plays a different role in middle-age and young-old (Spirduso, Francis, & MacRae, 2005). Reviews were identified which examined health promotion interventions around middle-age and young-old (Baxter et al., 2016; King, Rejeski, & Buchner, 1998). In order to conduct optimal life-style campaigns it is important to identify the motivators and barriers specific to the population being targeted (Baert, et al., 2011). There are broad influences upon

PA (interpersonal, environmental, individual) and these might vary across the life course (Bauman et al., 2012).

This review will explore differences and similarities in barriers and motivators between the ages of 50-64 years and 65-70 years, adopting an aged approach similar to the one used by Baxter et al. (2016). Synthesizing both qualitative and quantitative research on barriers and motivators can be used to better inform policy and research direction (Dixon-Woods, Argawal, Jones, Young, & Sutton, 2005). The Theoretical Domain Framework version-2 (TDF) was used as the guiding theoretical framework for this study. This framework was developed in 2005 and validated in 2012 (Atkins et al., 2017). TDF was developed from theories of behavior and behavior change for easier use by health professionals. The TDF has fourteen domains namely 1) knowledge, 2) skills, 3) social/professional role and identity, 4) beliefs about capabilities, 5) optimism, 6) beliefs about consequences 7) reinforcement, 8) intentions, 9) goals, 10) memory attention and decision process, 11) environmental context and resources, 12) social influences, 13) emotion 14) emotional and behavioral regulation. Each of these domains has different constructs for example the emotional domain includes stress, fear and anxiety. This framework has been used previously in systematic reviews to synthesize the influences of behaviors across different theoretical domains (Atkins et al., 2017). For example Rushforth et al. (2016) have used the TDF to identify barriers in the management of diabetes in primary care.

The aim of this review was to synthesize the literature on barriers and motivators of physical activity in middle aged (50-64 years) and older adults (65-70 years). The review objectives were to identify a) what are the barriers, encountered by middle aged and older adults, to being physical active and b) what motivates middle aged and older adults to be physically active? In this review the terms physical activity and exercise are used interchangeably.

Method

The study protocol was published on Prospero at: (https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=73810).

Inclusion Criteria

The inclusion criteria were adapted from Nightingale (2009) as follows:

- Type of study: qualitative research and quantitative, mixed-methods.
- Type of participants: people living in the community age fifty to seventy years.
    - Qualitative studies that presented quotes from these age groups.
    - Quantitative studies which examined changes in PA with age and have at least 50% of population in the included age group.
- Type of controls: Nil.
- Type of outcomes: motivators and barriers to participation in any form of physical activity (leisure, transport, work, household).
- Language: studies written in English.
- Studies were excluded if: a) they examined PA in specific conditions, such as diabetes, stroke, arthritis, b) interventional studies such as RCTs, c) carried out secondary analysis i.e. use data which were not primarily collected to address that specific research question. Such studies might miss out important confounding variables or their data might not be completely available to the researcher (Cheng & Phillips, 2014).

Definitions of Barriers and Motivators

In the context of PA, barriers are defined as factors that prevent or hinder participation (Rosenkranz, Kolt, & Berentson-shaw, 2013). The term motivator is a poorly defined concept (Plonczynski, 2000) which is a hypothetical construct used to describe internal and/or external forces that produce initiation, direction, intensity and persistence of behavior (Keegan,

Middleton, Henderson, & Girling, 2016). Facilitators and enablers are often used synonymously as they assist or make it easier for behavior to occur, and are a form of extrinsic motivation. In this review the search was limited to the term 'motivation' as it would identify both intrinsic and extrinsic motivation.

Information Source and Search Strategy

Five databases (Pubmed, Medline, Embase, Psycinfo, CINAHL Complete, and SPORTDiscus) were searched for articles. No date limit was set in order to identify all literature and possible differences across time. The literature search was carried out in July 2018. A search for grey literature was undertaken using the internet search engines Google and Google Scholar. This was done to identify any other evidence which was not indexed in bibliographic databases which would meet the aforementioned eligibility criteria. References lists from eligible studies and previous systematic reviews were reviewed to identify any additional studies which might have been relevant. The search strategy used in Pubmed is outlined in table 1. The search was modified according to the language used in the database.

Study Selection

The PRISMA state for reporting systematic reviews was used to ensure proper reporting of the entire process (Moher et al, 2009). Figure 1 presents the study selection process. Two authors (KS and AH) scanned all titles and abstracts and excluded studies that did not meet the criteria. After title screening the authors did not agree on forty-eight articles included in the abstracts to be reviewed. During abstract review there was disagreement on fourteen articles which were to be included in the full text review. When disagreement occurred in the full text review, KS and AH discussed until a consensus was reached mediated by a third member of the team. Included articles were then assessed for quality.

Study Quality

The Critical Appraisal Skill Program (CASP) (CASP UK, 2018) and modified CASP version were identified as potential quality assessment tools, however these do not cater for cross-sectional and mixed-methods studies. The Mixed Method Appraisal Tool (MMAT) does effectively cater for different study types so it was used in this review. This tool has criteria to assess qualitative, quantitative (including observational studies) and mixed-methods whilst positioning all types of studies on the same level (Pluye, Gagnon, Griffiths, & Johnson-Lafleur, 2009). Using the same tool to assess all the studies made it easier to assess outcomes. MMAT has reportedly good inter-rater reliability and is quick to use (Pace et al., 2012). It is has already been used in more than fifty published systematic reviews (Souto et al., 2015). The methodological quality of studies was assessed using the approaches described by Dixon-Woods et al. (2004; 2006). Dixon-Woods et al. (2004) quality assessment addresses study design, study reporting and relevancy. Studies classified as 'fatally flawed', i.e. those studies considered to be of poor design and reporting, and of low relevance, were excluded from the review. Articles achieving two out of the four criteria in the MMAT were included in the review. If the article had a low score but was determined to be of relevance because it contributed to the synthesis this was included. The MMAT score of all the articles is available in supplementary material 1.

Data Collection Process

A data extraction sheet was developed and piloted on ten articles (five qualitative and five quantitative) to ensure it met the needs of the analysis. The sheet was amended accordingly and the following data was collected from all studies: Code, title, reference, country, population, aim, theoretical perspective (example phenomenology), mode of data collection, sample size, age range, age mean/standard deviation, study type, behavioral theory used, PA measured, data sources/tools, response rate, follow-up, confounding variables

considered, barriers (50-64 years), motivators (50-64 years), barriers (65-70 years), motivators (65-70 years). Data extraction was carried out via paper and pencil and then transferred to Microsoft Word © to decrease legibility errors and to enable discussion between researchers (Elamin et al., 2009).

Data Analysis

Theory driven thematic framework analysis was used for the data analysis (Dixon-Woods et al., 2005). The TDF was used as a guiding theory as it includes domains from a variety of behavior change theories (BCT). The analysis presents the frequency in which domains within the TDF were identified in the different literature. Results were presented in a narrative format using quotes to validate the relevance of the identified domains.

Results

Study Selection

Figure 1 highlights the study selection process. There were a total of 9400 articles after the removal of duplicates. Following a review of abstracts a total of 298 articles met the inclusion criteria, and following a full text review this was reduced to 162. Sixty-nine quantitative articles were excluded as fifty percent of the population did not include in the age range. Eighteen qualitative articles were excluded as they did not differentiate between the two age groups being investigated. KS reviewed all the articles using MMAT whilst AM and JXDC reviewed a twenty-five percent sample of the total articles after a full text review to ensure the quality of the critical appraisal process. There was eighty-six percent agreement with AH and ninety-three percent agreement with JXDC. Discrepancies were dealt with by discussion between the reviewers until agreement was reached. The critical appraisal score are in supplementary material 1. From a total of fifty-five articles, six contained quantitative data

(see supplementary material 2), and forty-nine contained qualitative data (see supplementary material 3).

Study Participants

The majority of studies reviewed were from the World Health Organisation (WHO) Americas region: USA (thirty-three studies), and Canada (nine), Brazil (three), and Colombia (one). Thirteen studies were from different WHO European region: U.K. (six), Italy (two), Belgium (one), Ireland (two), and Netherland (two). Ten studies from WHO Western Pacific region: Australia (eight), New Zealand (one), and China (one). One study from WHO Eastern Mediterranean Region: Iran. The qualitative studies had a total sample size of 1970 participants, with focus groups and interviews being the most commonly used methods of data collection. Twelve studies used multi-method data collection. Twenty-three studies framed their theoretical perspective. The quantitative studies included data from 3524 participants. One study was longitudinal, the remaining were cross-sectional. The average sample size was thirty participants in qualitative and 587 for quantitative studies (range 472-840). Questionnaires were the most common tool used in quantitative studies. The questionnaire response rate ranged from thirty-nine to ninety-seven percent. The average sample size for qualitative studies was thirty participants (range 7-78). Interviews and focus groups were the most common tools used.

Behavioral Theories

Six quantitative studies and twenty-five qualitative studies adopted a BCT as the basis for the investigation. Fourteen different theories were used in all studies. BCT presented in table 2.

Qualitative Data

The results for the 50-64 year old group are presented in table 3; the results of the 65-70 year old group are presented in table 4. The percentage studies identifying barriers and

motivators within each TDF domain are presented in Figures 2 and 3 respectively. 'Environmental context and resources' were the most coded barriers in both groups, followed by social influences. 'Beliefs about capabilities' had a higher percentage of studies coded within the domain for the 65-70 year age group which identified as barrier then social influences. 'Social influences' was the most coded domain as motivator for both groups. This was followed by 'goals' for the 50-64 year old group, and reinforcement for 65-70 year old. No studies were coded under the 'Memory, attention and decision processes' domain. The extracted data is available in supplementary material 3.

Quantitative Data

Six studies met the inclusion criteria and achieved a 50% MMAT score. There were four studies that assessed barriers to PA quantitatively. Gobbi et al., (2012) was the only study with a higher proportion of participants in the 64-70 year age group. The study assessed barriers using the 'Barrier to PA Practice Questionnaire'(Hirayama, 2006 as cited in Gobbi et al., 2012). Analysis was carried out using age groups 60-69, 70-79 and more than 80 years of age. Within the study a statistical difference was found in the mean number of barriers reported between the 60-69 and 70-79 group.

Arras et al. (2006) examined health promoting behaviors among a population between 45-90 years. Barriers were measured using the 'Barriers to Health Promoting Activities for Disable People' (Becker, Stuifberge, & Sands, 1991). Correlation between barriers and age was carried out but no relationship was identified. Ayotte et al. (2010) carried out meditational analysis to explore how PA is influenced using social cognitive theory. One of the factors analyzed was perceived barriers using the 'Perceived Barrier to Exercise Scale' (Salmon, Owen, Crawford, Bauman, & Sallis, 2003). Within the model no correlation between barriers and age was identified. In the final model barriers had an indirect relationship with PA. Kowal & Fortier (2007) used a longitudinal study to investigate how

barriers and environmental characteristics influence PA behavior change. The authors used a sample with a mean age of fifty-one years (SD 6.7). Fourteen barriers, identified from previous literature, were assessed. Using a five year interval they examined differences in PA barriers with age. The authors identified that woman at the age of sixty years reported low level of physical barriers then other ages. Being too busy was reported more in the 50-54 year olds compared to sixty plus years. Health problems were most common in women older than sixty years.

Two studies which met the inclusion criteria investigated motivators (Dacey, Baltzell, & Zaichkowsky, 2008; Kolt, Driver, & Giles, 2004). The studies included both populations under study, but the percentage population could not be calculated. Kolt et al. (2004) had an average age of 63.6 years (SD 7.8). The study used the 'Participation Motivation Questionnaire for Older Adults' (Kirkby, Kolt, Habel, & Adams, 1999). It looked at reasons for participation in PA in older Australian exercisers. The study examined different types of motivators: social, fitness, recognition, challenges/benefits, medical, and involvement. Statistical analysis was undertaken to check for differences between 55-64 year olds and 65-74 year olds. Social reasons were rated higher in the middle-aged. There was a statistical difference in involvement and medical factors. No other statistical differences were reported with age group.

Dacey et al (2008) used the 'Exercise Motivation Inventory -2' (Markland & Ingledew, 1997), aimed to examine differences in intrinsic and extrinsic motivation between people with three different levels of exercise participation (Dacey et al., 2008). This study looked at six types of motivators: health and fitness, social/emotional benefits, weight management, stress management, enjoyment, and appearance. Statistical analysis was carried out for age groups 50-59 years old, 60-69 year old and 70-79 year old. Using MANOVA a

significant score was found between 50-59 year old and 60-69 year old within the appearance and stress management scores being higher in 50-59.

Discussion

The aim of this review was to synthesize the literature on barriers and motivators of PA in middle aged (50-64 years) and older adults (65-70 years). With the barriers identified, there were similarities with age groups but clear differences in the motivators were found. The analysis of qualitative literature identified factors that acted as both a barrier and a motivator. For example, previous experience of being physically active was identified as a motivator, whilst the lack of it was identified as a barrier. Similar barriers and motivators were extracted for both age groups from the qualitative studies.

However, in the quantitative literature, differences between the age groups were not consistent which is partly explained by the use of different tools. This lack of statistical difference might also be explained by the similar barriers identified between the two groups in the qualitative literature. In analyzing the result of the qualitative studies, using the TDF, data did not fit within certain domains such as 'Memory, attention and decision processes'. From the analysis it is not possible to conclude whether these are not important or because of a lack of research.

When compiling the results from the qualitative studies, differences in barriers between the two age groups which were partly supported in the quantitative studies were found. The 65-70 year old age groups identified these barriers which were not present in the other group. In one study (Melillo et al., 2001) this group identified fears about safety to carry out PA. Health problems were identified as a barrier more frequently in this group. This was also identified in one quantitative study (Kowal & Fortier 2007). Lack of guidance from healthcare professionals to start PA was another factor present only in this group. Being

labeled too old to carry out PA was a factor only identified within the young-old group. A person's perception of self is influence by their social relations with others (Evans & Crust, 2015). The young-old mentioned fear of falling as barrier which was only present in this group. In the middle-aged group work conditions were identified as barrier which was not present in the other group. This is expected as people usually retire by the age of sixty-five years (Ekerdt, 2010). Barriers with time management were identified in studies looking at middle-aged.

Issues of being busy were reported more often in middle-aged also which was highlighted in the qualitative study. Barriers within behavior regulation such as issues of laziness were more prevalent in the younger group. Laziness was identified as idleness to engage in PA and remaining sedentary. In a study (Belon, Nieuwendyk, Vallianatos, & Nykiforuk, 2016) participants in this age group identified the difficulty in breaking the cycle of using the car as a barrier to engaging in PA.

Differences were identified with respect to motivators between the two groups. A motivator to be active identified only in the middle aged was the issue of being a role model for their children. Another motivator mentioned by this age group only was fear of becoming ill. Both groups identified health reasons as a motivator for engaging in PA, however, middle-aged identified set targets of weight management or stress management. The young-old mentioned staying health or staying independent as health motivator. Lifelong activity was a motivator for the older group. Social motivators were identified by both groups, but being part of a group and PA as an opportunity to socialize was mentioned more often in the young-old. The young-old identified retirement as a motivator to become active. PA provided young-old with a purpose in life, and another study identified PA as an opportunity to be busy. These motivators where not identified in middle-aged.

Comparison with previous reviews

The findings of the current review are comparable to Schutzer & Graves (2004) in the oldest old age group in that barriers and motivators were similar. Few behavior regulation techniques were identified in the current review since it did not include interventional studies. Schutzer & Graves (2004) had identified prompt such as the telephone interventions and the use of music. Compared to reviews by Baert et al. (2011) and Burton et al. (2017) this review used the TDF to analyze the findings whilst the other reviews used the socio-ecological approach. This framework makes it possible to use results from the review in interventional studies using different behavior change theory, as it incorporates concepts from different theories. If an interventional study is set to target knowledge or goals these can be identified through the results of this review. The list of barriers and motivators identified were similar to those of the two previous reviews, however it was able to differentiate between the middle-aged and young-old. The findings support previous findings from Allender et al. (2006). Whilst their review was limited to UK studies this included findings from four WHO regions and thirteen countries. This shows that factors might be transferrable across different populations.

The use of behavior change theory

Nearly half of the reviewed studies, (forty-six percent), had a theoretical underpinning. The socio-ecological theory was the most commonly used, probably because of the simplicity of using this theory. Using a theoretical framework added context to what is being investigated and to what type of influences are being identified (Atkins et al., 2017). Within the analysis of this review certain TDF domains were not identified. It was not possible to identify whether this was because the domain has not been researched or lack of importance in the context.

Strengths and Limitations

The strengths of this review were the inclusion of both qualitative and quantitative studies to get a broader perspective of barriers and motivators. There is a paucity of data on the age groups included, so this review has extended the knowledge of what is an under studied topic and population with, previous studies focusing on either middle-age adults (>60) or the oldest old (80+). However, this review is not without its limitations.

The major limitation of this review is publication bias and the use of English language studies only. The use of only one reviewer in the critical appraisal phase might increase error (Buscemi, Hartling, Vandermeer, Tjosvold, & Klassen, 2006). This risk was reduced by having two reviewers assessing an appropriate enough number of articles to ensure rigorous standards were met. The systematic review used two reviewers, in the screening phase to ensure that no studies were excluded in the review (Edwards et al., 2002). The use of one quality appraisal tool (MMAT) might lack specificity since it is a generic tool which can be used for all study. By using this tool the articles were assessed using the same measure, including mixed-methods studies (Pace et al., 2012).

In the majority of studies both PA and exercise were used interchangeably. This might have limited specificity of certain barriers or motivators. As Burton et al., (2017) suggested, some barriers and motivators might be common across all forms of PA types but some might be specific as in the case of strength training. As identified in previous literature the term motivator was used in different context by different authors (Plonczynski, 2000). At times, the term facilitator and enablers were used interchangably in the studies. Given that these definitions refer to a continuum making it clear at the beginning of the study to define what is meant by motivation and what aspects are being examined would make comparison of studies easier and specific.

Implications of the findings

This review identifies that barriers and motivators encountered by middle-aged and young-old are similar. The review has achieved its aim of identifying barriers that prevent people from being physically active. It has also identified motivators which health professionals and PA promoters should have knowledge of to encourage behavior change in these age groups. The identified barriers were similar, but there were differences in the motivators between the two age groups which those developing and implementing interventions need to be aware of.

The effects of the aging body were identified by studies as early as middle-aged (George, Kolt, Rosenkranz, & Guagliano, 2014). This review identified environmental barriers such as cost, weather, and facilities as barriers to undertaking PA for both age groups. The social context is important, especially the family role, which can act either as a motivator or barrier. Given the variety of barriers and motivators identified within the studies, health professionals and physical activity promoters need to be aware of the broad characteristics which might influence the uptake of PA or motivate its uptake.

This review highlights the complexity of PA influences with multiple factors being identified from different domains of the TDF. Even though the review was limited to community dwelling individuals and not specific patient groups, health problems were identified as barriers for PA by both groups, especially young-old. Professionals need to be aware of these limitations and teach individuals to be active within the constraints of their health limitation. Any form of community intervention within these population age groups needs to consider health problems and past injuries. The findings support the life course approach to PA, as past master and previous experience of PA was identified as a motivator to being physically active.

Future Research Recommendations

The issue of laziness mentioned in studies of middle-aged requires further exploration in order to understand its meaning. Studying the link between different identified factors would be of interest and would highlight the most influential factor. Meditational analysis would help in identifying these factors. There is a need for further quantitative studies which compare the importance of barriers and motivators at different age groups. Longitudinal studies are also needed to assess how and whether there are any changes across an individual's life span. Awareness of how motivators change with age can assist in keeping the older adults active.

Conclusion

Kowal & Fortier (2007) highlighted it is important to identify age-specific PA barriers as this can assist targeted interventions. This study has synthesized and extends the body of knowledge on PA barriers and motivators in older adults by discussing the differences between the age groups of 50-64 years and 65-70 years. For the 50-64 year group, environmental and resources, social influence and difficulty in regulating behavior were the key barriers. The key motivator was set goals, such as fitness, stress relief or taking dog out. For the 65-70 years group the key motivators were different forms of reinforcement such as peer encouragement and having fun, the social aspect of PA and support from health professionals. The key barriers were lack of belief in capabilities, environmental and social such as family roles or lack of support from family. It is therefore apparent that differences in barriers and motivators between the two groups were minimal, but differences are present.

The majority of the key barriers and motivators were identified through qualitative literature. It was not possible to identify the importance of these factors for each group because of the lack of quantitative data over an extended period of time to ascertain if barriers

and motivators change with age. The review identifies the need for more longitudinal studies to assess how barriers and motivators change over time within individuals.

There are clear discrepancies relating to how barriers and motivators are measured which could be due to the wide characterization of these constructs so standardization is needed in order to more effectively compare and contrast studies. Healthcare professionals and physical activity promotion specialists working with older adults should be made aware of the findings of this study as key barriers and motivators can encourage engagement with and adherence to physical activity.

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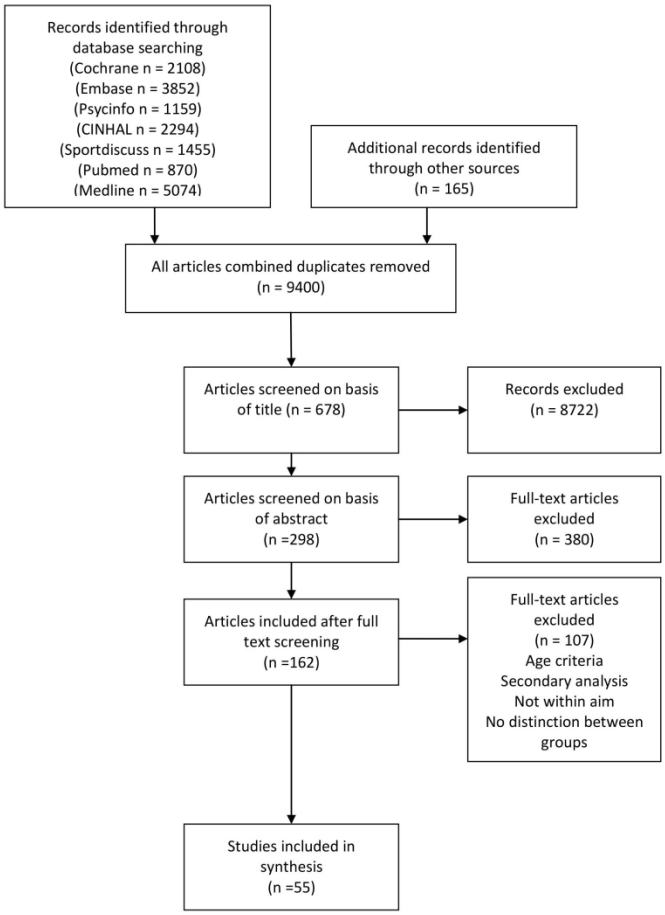

Figure 1. Study selection flowchart (PRISMA, 2015)

215x279mm (300 x 300 DPI)

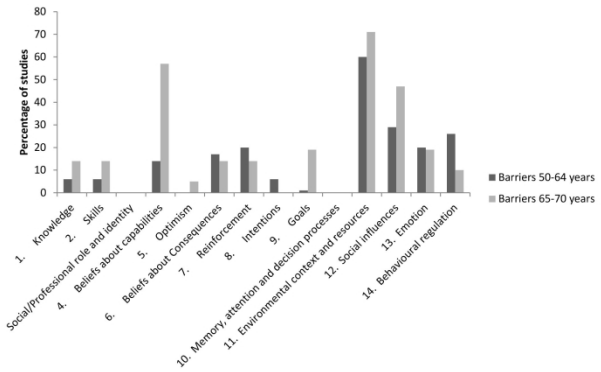

Figure 2. Percentage of studies identifying barriers by TDF domain

297x210mm (300 x 300 DPI)

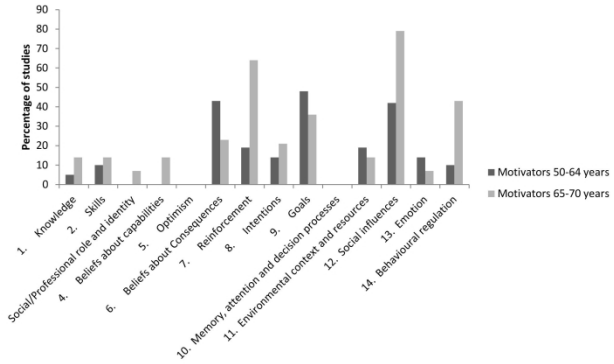

Figure 3. Percentage of studies identifying motivators by TDF domain

297x210mm (300 x 300 DPI)

Table 1

Search Strategy (using Pubmed terminology)

1	barrier* ti,ab.
2	motivat* ti,ab.
3	1 or 2
4	adult (MESH)
5	adult* ti,ab.
6	aged (MESH)
7	Older adult ti,ab.
8	4 or 5 or 6 or 7
9	exercise (MESH)
10	sport (MESH)
11	motor activity (MESH)
12	physical activity ti,ab.
13	exercise ti,ab.
14	sport* ti,ab.
15	9 or 10 or 11 or 12 or 13 or 14
16	3 and 8 and 15

Note: ti is title, ab is abstract

Table 2
Behavior change theories used in studies

Behavior Change Theory	Number of Studies	References
ANGELO framework	One	Belon, Nieuwendyk, Vallianatos, & Nykiforuk, 2016,
Health belief model	Two	Das, Sartore-Baldwin, & Mahar, 2016; Wertman et al., 2016
Integrated behaviour change	One	Arnautovska, O'Callaghan, & Hamilton, 2017
Kleinman's explanatory models	One	Evans, 2011
Pender's health promotion theory	One	Arras, Ogletree, & Welshimer, 2006
Positive deviance theory	Two	Harley, Rice, Walker, Strath, & Quintiliani, 2014; Kegler et al., 2013
Self-determination theory	Two	Dacey, Baltzell, & Zaichkowsky, 2008; Gray et al., 2016
Self-efficacy theory	Two	Kalavar, Kolt, Giles, & Driver, 2004; Kolt, Paterson, & Cheung, 2006
Self-regulating theories	One	Romeike et al., 2016
Socio-cognitive theory	Five	Ayotte, Margrett, & Hicks-Patrick, 2010; Chrisman, Nothwehr, Yang, & Oleson, 2015; Cousins, 2003; Gothe & Kendall, 2016; Kosteli & Williams, 2016
Socio-ecological theory	Thirteen	Ball, Salmon, Giles-Corti, & Crawford, 2006; Brittain, Baillargeon, McElroy, Aaron, & Gyurcsik, 2006; Casey, Eime, Ball, & Payne, 2011; Dave et al., 2015; Gobbi et al., 2012; Gonzales & Keller, 2004; Kaiser & Baumann, 2010; Kegler et al., 2013; Kowal & Fortier, 2007; Mathews, Lakshmi, Ravindran, Pratt, & Thankappan, 2016; Royce et al., 2003; Sebastião et al., 2015; Sebastião, Ibe-Lamberts, Bobitt, Schwingel, & Chodzko-Zajko, 2014
Socio-emotional selectivity theory	One	Steltenpohl, Shuster, Peist, Pham, & Mikels, 2018
Success model	One	Harley et al., 2014
Theory of planned behaviour	Two	Kamphuis, van Lenthe, Giskes, Brug, & Mackenbach, 2007; Romeike et al., 2016

Table 3
Barriers and motivators for 50-64 years old

	TDF domain	Number of Studies	Barriers 50-64 years	Number of Studies	Motivators 50-64 years
1.	Knowledge	Two	• Participants were not aware of the benefits of engage in regular PA and the need to be active (Das, Sartore-Baldwin, & Mahar, 2016). • PA at work was identified as enough to get the necessary benefits (Das et al., 2016). • Participants in the study expressed the perception that PA is not congruent with a busy lifestyle (Royce et al., 2003).	One	• Knowledge of the need to participate in PA "You know it's like what they say if you don't use your muscles, you lose it" (Gray et al., 2016, p. 422).
2.	Skills	Two	• Participants identified themselves as lacking the necessary skill to carry out exercise (Das et al., 2016; Mosquera et al., 2012). "I need direction based as far as this particular exercise you need to do x times a day to get these results. I need a plan" (Das et al., 2016, p. 954).	Two	• Previous experience gave the necessary confidence for participants to continue practicing PA. A military background (Kegler et al., 2013) or because of participation since younger (Rathanaswami, Bengoechea, & Bush, 2016) "I guess it's always been in, been embedded within me to, fitness…early on I just grew up with the desire to be physically fit and to stay active…" (Kegler et al., 2013, p. 11).
3.	Social/Professional role and identity	Nil	• Nil	Nil	• Nil
4.	Beliefs about	Five	• Past injuries and medical conditions	Nil	• Nil

	capabilities		were barriers which influenced the participants perceptions about their capability to carry out PA (Casey, Eime, Ball, & Payne, 2011; Evans, 2011; Van Dyck, Mertens, Cardon, De Cocker, & De Bourdeaudhuij, 2017). "While swimming is good for my back, the last few years I can't do that. The pain has gone down my legs. I can't even do swimming . . . It hurts so much because my life is not the same anymore. I can't do physical activity" (Casey et al., 2011, p. 8). • The aging body hindered the participants from participating in PA (George, Kolt, Rosenkranz, & Guagliano, 2014). • A history of sedentary lifestyle was seen to influence their capabilities to carry out PA (Harley, Rice, Walker, Strath, & Quintiliani, 2014).		
5.	Optimism	Nil	• Nil	Nil	• Nil
6.	Beliefs about Consequences	Six	• Pain during exercise or fear of pain after exercise (Das et al., 2016; Gonzales & Keller, 2004; Mathews, Lakshmi, Ravindran, Pratt, & Thankappan, 2016). • Fear of injury (Buman, Daphna Yasova, & Giacobbi, 2010). • Poor past exercise experience, either as lack of performance or labelling acted as a barrier toward PA (McArthur, Dumas, Woodend, Beach,	Nine	• For health benefits (physical and mental) and disease prevention (Bopp et al., 2007; Caperchione et al., 2012; Chatfield, 2015; George et al., 2014; Gray et al., 2016; Harley et al., 2014; McArthur et al., 2014; Wertman et al., 2016). • Feeling good, energetic "Now that I have started walking and getting exercise, it makes me have more ambition so I just can't sit. So actually,

			& Stacey, 2014). • Exercise seen as a physical strain and therefore it is avoided (Harley et al., 2014).		what exercise is doing is making me be more energetic" (Kegler et al., 2013, p. 11).
7.	Reinforcement	Seven	• Due to a bad experience with the health system participants did not participate in PA, as health professionals did not support them (Casey et al., 2011). • Conditions at work was a barrier in one study (Ball, Salmon, Giles-Corti, & Crawford, 2006). • Lacking a partner or a group with whom encourage participation (Evans, 2011; Paluck, Allerdings, Kealy, & Dorgan, 2006; Royce et al., 2003; Van Dyck et al., 2017). • Attending classes which lacked structure was not stimulating (McArthur et al., 2014).	Four	• Fun and enjoyment of participating in PA (McArthur et al., 2014). • Positive feeling when being active (McArthur et al., 2014) • Gratification "My doctor was very happy with me . . . She was like you've lost 8 pounds since the last time you were here . . . When I hear my doctor say that it just makes me want to keep going" (Harley et al., 2014, p. 362). • Encouragement from others (Keegan, Middleton, Henderson, & Girling, 2016; Steltenpohl, Shuster, Peist, Pham, & Mikels, 2018).
8.	Intentions	Two	• PA identified not a priority but an inconvenience (Mohamed et al., 2014; Royce et al., 2003). "... people cannot keep it up. They won't have time, are looking for food, or a job and pay check" (Mohamed et al., 2014, p. 39).	Three	• PA was intentionally "me time" (Keegan et al., 2016, p. 8). • Faith was the motivation to participate in PA "It's a known fact in order for you to have faith you have to have a healthy mind and to exercise your mind is exercising your faith" (Bopp et al., 2007, p. 818). • Being a role model for their children (Chrisman, Nothwehr, Yang, & Oleson, 2015).
9.	Goals	Six	• No motivation to carry out PA (Ball et	Ten	• Taking their dog out as their goal for

		al., 2006; Evans, 2011; George et al., 2014; Mathews et al., 2016; Romeike et al., 2016; Van Dyck et al., 2017).		undertaking PA (Belon, Nieuwendyk, Vallianatos, & Nykiforuk, 2016; Kamphuis, van Lenthe, Giskes, Brug, & Mackenbach, 2007; Kegler et al., 2013). • Health goals, either stress management, keep health, weight loss or fitness as their goal for undertaking PA(Caperchione et al., 2012; Chatfield, 2015; George et al., 2014; Harley et al., 2014; Kegler et al., 2013). "I think it's pretty ridiculous to get old and just turn into a little old man..." (Chatfield, 2015, p. 969). • Will power (Bopp et al., 2007). • Doing something different (McArthur et al., 2014). • A sense of competition (Mohamed et al., 2014).
10. Memory, attention and decision processes	Nil	• Nil	Nil	• Nil
11. Environmental context and resources	Twenty-one	• Cost and affordability of carrying out PA was mentioned as a barrier (Buman et al., 2010; Casey et al., 2011; Harley et al., 2014; Mohamed et al., 2014; Van Dyck et al., 2017; Wertman et al., 2016)). • Environmental barriers such as lack of safety, poor footpaths, aesthetics (Belon et al., 2016; Bruner & Chad, 2013; Kamphuis et al., 2007; Mosquera et al., 2012; Royce et al., 2003).	Four	• Safe environment (Gray et al., 2016) • Appealing environment example walking paths, possibility to change scenery (George et al., 2014; Keegan et al., 2016; Mathews et al., 2016) • Favourable Weather (Gray et al., 2016).

		• Weather extremes (Bruner & Chad, 2013; Chatfield, 2015; Evans, 2011; Kamphuis et al., 2007). • Lack of facilities for particular groups (Casey et al., 2011; McArthur et al., 2014; Paluck et al., 2006; Royce et al., 2003; Van Dyck et al., 2017). • Problems with accessibility due to distance (Mohamed et al., 2014; Paluck et al., 2006; Royce et al., 2003). • Not enough time due to other obligations mostly work and family (Chatfield, 2015; Das et al., 2016; Evans, 2011; George et al., 2014; Mathews et al., 2016; Romeike et al., 2016; Van Dyck et al., 2017; Wertman et al., 2016). • Temporal illness (Chatfield, 2015).		
12. Social influences	Ten	• Culture was identified as barrier as it was not part of the culture (Casey et al., 2011; Mohamed et al., 2014; Mosquera et al., 2012; Royce et al., 2003). "If you give an old (Somali man) a pair of shorts and Somali women see him running, Somali women would say he is crazy." (Mohamed et al., 2014, p. 39). • Family and friends influence was a barrier (Evans, 2011; George et al., 2014; Gonzales & Keller, 2004). • The family role was in competition with PA (Caperchione et al., 2012;	Eleven	• Role models (Keegan et al., 2016; Mohamed et al., 2014). • Social aspect of PA (Belon et al., 2016; George et al., 2014; Harley et al., 2014; Mathews et al., 2016; Steltenpohl et al., 2018; Wertman et al., 2016). "The classes to me, motivated me . . . it was a group activity and I could be with people, and I could talk. . . that way I get a little social connection" (Harley et al., 2014, p. 362). • Family and friends (George et al., 2014; Gonzales & Keller, 2004; Kegler

		Gonzales & Keller, 2004; Rathanaswami et al., 2016). "Some women take maybe a year to come out and try to do something for [themselves] because they always put their families, their husbands or whoever at home first before they attend to their needs to improve themselves . . ." (Rathanaswami et al., 2016, p. 113).		et al., 2013; Steltenpohl et al., 2018).
13. Emotion	Seven	• A negative past experience with exercise was a barrier towards PA (Buman et al., 2010; Casey et al., 2011; Mosquera et al., 2012; Royce et al., 2003). • Feelings of fatigue (Gonzales & Keller, 2004; McArthur et al., 2014; Royce et al., 2003). • Not in the mood (McArthur et al., 2014). • Embarrassment to exercise as a barrier (Mohamed et al., 2014).	Three	• PA provided them with a sense of vitality good feeling (Bopp et al., 2007; Kegler et al., 2013). • Fear of becoming ill therefore they are active (Caperchione et al., 2012).
14. Behavioural regulation	Nine	• Break the habitual cycle of using the car (Belon et al., 2016). • Lacking time management skills either because of a lot of thing to do (Ball et al., 2006) or too much free time after retirement (Van Dyck et al., 2017). • Laziness prevented participants from getting into the routine of engaging in PA (Alizadeh & Salehi, 2015; Caperchione et al., 2012; Evans, 2011; George et al., 2014; Gonzales &	Two	• Health professionals and a military background were the motivators for participating in PA "My oncologist tells me to exercise and stays on my butt about my weight" (Kegler et al., 2013, p. 10). • Guilty of not being active was the other behavioural regulation in this age group (George et al., 2014).

	Keller, 2004). “I’ve actually seen a big difference in me from when I was 45 to where I am now, that I’ve actually become more lazy . . .in terms of doing physical activity” (George et al., 2014, p. 153). “Everyone knows that exercise is good for health but laziness don’t allow me to exercise..” (Alizadeh & Salehi, 2015, p. 293). • Self-sacrifice to accommodate others (McArthur et al., 2014).

Note: TDF is Theoretical Domain Framework

Table 4

Barriers and motivators for 65-70 years old

	TDF domain	Number of Studies	Barriers 65-70 years	Number of Studies	Motivators 65-70 years
1.	Knowledge	Three	• Queries or fear about safety to carry out PA (Melillo et al., 2001). • Lacked knowledge on exercise (Gray et al., 2016; Kolt, Paterson, & Cheung, 2006). "We have to be educated by professional people before go ahead with our exercise" (Kolt et al., 2006, p. 121). • Not aware of the benefits of PA (Kolt et al., 2006).	Two	• Knowledge of the benefits of PA (Mitra, Siva, & Kehler, 2015). • Media was considered a source of knowledge which motivated participate to engage in PA (Arnautovska, O'Callaghan, & Hamilton, 2017).
2.	Skills	Three	• Lack of skill (Gray et al., 2016; Kolt et al., 2006). "I think it depends on the person you know, depends what they can do" (Gray et al., 2016, p. 424). • No past experience of exercise (Kalavar, Kolt, Giles, & Driver, 2004).	Two	• Past mastery of activities (Cousins, 2003). • A life history of PA participation (Guell, Panter, Griffin, & Ogilvie, 2018).
3.	Social/Professional role and identity	Nil	• Nil	One	• Participants undertook PA for pride (Arnautovska et al., 2017).
4.	Beliefs about capabilities	Twelve	• Health problems were barriers to PA. These limited their capability to participate PA example breathlessness and pain (Cassou et al., 2011; Guell et al., 2018; Guell, Shefer, Griffin, & Ogilvie, 2016; Jancey, Clarke, Howat, Maycock, & Lee, 2009; Kalavar et al., 2004; Kolt et al., 2006; Leavy & Aberg,	Two	• Past experience of PA was a motivator which helped in adapting to new forms of PA as one got limited by aging changes (Kosteli & Williams, 2016). • Lifelong activities made them believe in their capabilities (Guell et al., 2016).

			2010; Miller & Brown, 2017; Mitra et al., 2015; Sebastião, Ibe-Lamberts, Bobitt, Schwingel, & Chodzko-Zajko, 2014; Sebastião et al., 2015). ". . .Oh need a new knee. I need a new knee replacement" (Sebastião et al., 2014, p. 8) • Aging was an identified barrier (Arnautovska et al., 2017; Ceria-Ulep, Serafica, & Tse, 2011; Kalavar et al., 2004). • Poor body image of capabilities (Jancey et al., 2009)		
5.	Optimism	One	• Lack of a positive outlook toward participant in PA. "There's no point in starting something if you don't know if you can continue it. I have never been a candidate for anything that is too active" (Cousins, 2003a, p. 442).	Nil	• Nil
6.	Beliefs about Consequences	Three	• Participants' believed that exercise could cause them pain or risk them injury (Arnautovska et al., 2017; Kalavar et al., 2004). "You have to do everything in moderation. I cannot begin exercise by lifting weights now suddenly. I will cause more problems than I already have" (Kalavar et al., 2004, p. 62). • Fear of falling (Gallagher et al., 2010).	Five	• Participation in PA was for health benefits and well-being (Arnautovska et al., 2017; Gray et al., 2016; Guell et al., 2018; Henwood, Tuckett, Edelstein, & Barlet, 2011; Miller & Brown, 2017). "It (PA) has definitely changed my life. It has lifted the depression big time" (Gray et al., 2016, p. 422).
7.	Reinforcement	Three	• Lack of support from friends or family (Cassou et al., 2011; Guell et al., 2016). • The presence of people was identified as	Nine	• Fun and enjoyment in doing PA (Arnautovska et al., 2017; Gray et al., 2016; Kosteli & Williams, 2016; Miller

			a barrier when carrying out PA (Gallagher et al., 2010).		& Brown, 2017). "Aye you have to enjoy it encourages you to do it, when you are feeling good it spurs you on, gives you that confidence to know you are doing it right" (Gray et al., 2016, p. 422). • Feel good factor (Leavy & Aberg, 2010; Miller & Brown, 2017). • Encouragement (Cousins, 2003; Sebastião et al., 2014) • Peer encouragement (Kalavar et al., 2004). • Positive experience (Mitra et al., 2015).
8.	Intentions	Nil	• Nil	Three	• To stay health or maintain independence (Gray et al., 2016; Kosteli, Williams, & Cumming, 2016). • A conscious decision to participate in PA, "So when I retired I decided that I wasn't going to go hankering after my old workmates but that I would create new relationships around. As a result I became a lot more active and a lot more involved. . . ." (Leavy & Aberg, 2010, p. 226).
9.	Goals	Four	• No motivation (Ceria-Ulep et al., 2011; Guell et al., 2018; Kalavar et al., 2004; Kolt et al., 2006).	Five	• To improve health (Henwood et al., 2011). • PA provided a purpose in life (Kosteli & Williams, 2016). • Sense of competition (Chatfield, 2015; Gray et al., 2016) • A sense of self-motivation (Kalavar et al., 2004).

10. Memory, attention and decision processes	Nil	• Nil	Nil	• Nil
11. Environmental context and resources	Fifteen	• Cost (Cassou et al., 2011; Gray et al., 2016; Miller & Brown, 2017; Sebastião et al., 2015). • Retirement as a busy period (Guell et al., 2018) • Weather (Alizadeh & Salehi, 2015; Arnautovska et al., 2017; Cassou et al., 2011; Jancey et al., 2009; Kalavar et al., 2004; Mitra et al., 2015; Sebastião et al., 2014) • Lack of time (Arnautovska et al., 2017; Cassou et al., 2011; Gray et al., 2016; Kalavar et al., 2004) • Environmental such as traffic, lack of green areas (Alizadeh & Salehi, 2015; Chaudhury, Mahmood, Michael, Campo, & Hay, 2012; Gallagher et al., 2010; Kalavar et al., 2004; Leavy & Aberg, 2010; Mitra et al., 2015; Rathanaswami, Bengoechea, & Bush, 2016) • Lack of facilities (Gray et al., 2016) • Neighbourhood safety (Arnautovska et al., 2017; Cassou et al., 2011; Chaudhury et al., 2012; Gallagher et al., 2010; Kolt et al., 2006; Mitra et al., 2015; Sebastião et al., 2015, 2014) • Transport (Gray et al., 2016; Kolt et al., 2006).	Two	• Environmental aesthetics (Arnautovska et al., 2017). • A sense of safety and nice environment "I love to hear the birds singing in the morning" (Gallagher et al., 2010, p. 104), "We walk around [the outside of] the hospital, because they have all kinds of cameras, and police there, and it's safe, very safe" (Gallagher et al., 2010, p. 104).
12. Social influences	Ten	• Family as a barrier, because of their age they were over protective and did not	Eleven	• The social component was important, being part of a group was an opportunity

		expect them to participate in PA not to hurt themselves (Kolt et al., 2006). • Labelled as too old to carry out PA (Jancey et al., 2009). • PA not being part of culture "If we start now suddenly, then others will tease us that we are trying very hard to be youthful" (Kalavar et al., 2004, p. 60). • The family role (Cassou et al., 2011; Ceria-Ulep et al., 2011; Gray et al., 2016; Rathanaswami et al., 2016; Sebastião et al., 2015). • Social isolation (Cassou et al., 2011). • Not willing to mix with other cultures (Kolt et al., 2006). • Uncontrollable life circumstances (Miller & Brown, 2017).		to meet people (Gallagher et al., 2010; Gray et al., 2016; Guell et al., 2018; Henwood et al., 2011; Kosteli & Williams, 2016; Leavy & Aberg, 2010; Miller & Brown, 2017; Sebastião et al., 2015). "I walk every morning. There are people out there at this time of year, at 5:30 or 6:00 [a.m.], as soon as it's light. They will say, 'Hey, you're late!' Everybody knows each other" (Gallagher et al., 2010, p. 103). "That would be the top reason for me, certainly, meeting friends and enjoying yourself, meeting new people" (Gray et al., 2016, p. 422). • Family and friends involvement (Cousins, 2003; Miller & Brown, 2017; Sebastião et al., 2015, 2014). "Every fortnight, I have a friend I used to work with, and we go for quite a long walk. Maybe anything from sort of seven to fourteen miles we do on that" (Guell et al., 2016, p. 4). • Part of a group "to remove solitude" (Miller & Brown, 2017). • Comparison with others (Chatfield, 2015). • Part of the social norm (Guell et al., 2016). • Retirement as an opportunity to be active (Leavy & Aberg, 2010).
13. Emotion	Four	• Participants mentioned guilt feelings of dedicating time to self rather than family as a barrier (Rathanaswami et al., 2016).	One	• PA as a way to regulate their mood, "I think I would be quite depressed if I didn't do physical exercise of some

		• Embarrassment of carrying out PA (Kolt et al., 2006; Melillo et al., 2001). • Fatigue (Ceria-Ulep et al., 2011).		manner" (Kosteli et al., 2016, p. 736).
14. Behavioural regulation	Two	• Lack of guidance from health professionals to start PA was a barrier (Kolt et al., 2006). • Not wanting to change routine and start some new was a barrier (Kalavar et al., 2004).	Six	• Health professionals were the source of behaviour regulation (Arnautovska et al., 2017; Ball, Salmon, Giles-Corti, & Crawford, 2006; Cousins, 2003; Kalavar et al., 2004). • Identified PA as a way to make life busy (Guell et al., 2018). • Part of a routine (Miller & Brown, 2017).

Note: TDF is Theoretical Domain Framework

Supplementary material 1
MMAT scores

Critical Appraisal Score

Reference	MMAT question number							
	Qual 1.1	Qual 1.2	Qual 1.3	Qual 1.4	Quan 1.1	Quan 4.2	Quan 4.3	Quan 4.4
Alizadeh & Salehi, (2015)	x		x					
Arnautovska, O'Callaghan, & Hamilton, (2017)	x	x	x	x				
Arras, Ogletree, & Welshimer, (2006)					x	x	x	
Ayotte, Margrett, & Hicks-Patrick, (2010)					x	x	x	
Ball, Salmon, Giles-Corti, & Crawford, (2006)	x	x	x					
Belon, Nieuwendyk, Vallianatos, & Nykiforuk, (2016)	x	x	x					
Bopp et al., (2007)	x	x	x					
Bruner, (2009)	x	x	x					
Buman, Daphna Yasova, & Giacobbi, (2010)	x	x	x					
Caperchione et al., (2012)	x	x	x					
Casey, Eime, Ball, & Payne, (2011)	x	x	x					
Cassou et al., (2011)	x	x	x					
Ceria-Ulep, Serafica, & Tse, (2011)	x	x	x					
Chatfield, (2015)	x	x		x				
Chaudhury, Mahmood, Michael, Campo, & Hay, (2012)	x	x						
Chrisman, Nothwehr, Yang, & Oleson, (2015)	x	x						
Cousins, (2003)	x	x	x					
Dacey, Baltzell, & Zaichkowsky, (2008)						x	x	
Das, Sartore-Baldwin, & Mahar, (2016)	x		x					
Evans, (2011)	x	x	x					
Gallagher et al., (2010)	x	x	x					
George, Kolt, Rosenkranz, & Guagliano, (2014)	x	x	x					
Gobbi et al., (2012)					x	x	x	
Gonzales & Keller, (2004)	x	x	x					

Gray et al., (2016)	x	x	x				
Guell, Panter, Griffin, & Ogilvie, (2018)	x	x	x				
Guell, Shefer, Griffin, & Ogilvie, (2016)	x	x	x				
Harley, Rice, Walker, Strath, & Quintiliani, (2014)	x	x	x				
Henwood, Tuckett, Edelstein, & Barlet, (2011)	x	x	x				
Jancey, Clarke, Howat, Maycock, & Lee, (2009)	x		x				
Kalavar, Kolt, Giles, & Driver, (2004)					x	x	x
Kamphuis, van Lenthe, Giskes, Brug, & Mackenbach, (2007)	x	x	x				
Keegan, Middleton, Henderson, & Girling, (2016)	x	x	x	x			
Kegler et al., (2013)	x	x	x				
Kolt, Driver, & Giles, (2004)					x	x	x
Kolt, Paterson, & Cheung, (2006)	x	x	x				
Kosteli, Williams, & Cumming, (2016)	x	x	x	x			
Kowal & Fortier, (2007)					x	x	x
Leavy & Aberg, (2010)	x	x					
Mathews, Lakshmi, Ravindran, Pratt, & Thankappan, (2016)	x	x	x				
McArthur et al., (2014)	x	x	x				
Melillo et al., (2001)	x	x	x				
Miller & Brown, (2017)	x	x					
Mitra, Siva, & Kehler, (2015)	x	x	x				
Mohamed et al., (2014)	x	x	x				
Mosquera et al., (2012)	x	x	x				
Paluck, Allerdings, & Kealy, (2006)		x	x				
Rathanaswami, Bengoechea, & Bush, (2016)	x	x	x				
Romeike et al., (2016)	x	x	x				
Royce et al., (2003)	x	x	x				
Sebastião et al., (2015)	x	x	x				
Sebastião, Ibe-Lamberts, Bobitt, Schwingel, & Chodzko-Zajko, (2014)	x	x	x				

Steltenpohl, Shuster, Peist, Pham, & Mikels, (2018)	x	x	x		
Van Dyck, Mertens, Cardon, De Cocker, & De Bourdeaudhuij, (2017)	x	x			
Wertman et al., (2016)	x	x	x	x	x

Note: 'x' denotes articles reached criteria.

MMAT is Mixed Methods Appraisal Tool

Supplementary Material 2

Characteristics of studies containing quantitative data

Reference	Country	Sample	Age Range (years)	% Population within studied population	Behaviour theory	Barrier tool	Motivator tool
Arras et al., (2006)	USA	641	45-90	53.1	Health promotion model	Barriers to health promoting activities for disable people	Not assessed
Ayotte et al., (2010)	USA	472	50-75	100	Social cognitive theory	Perceived barriers to exercise scale	Not assessed
Dacey et al., (2008)	USA	703	50-79	53	Self-determination theory and transtheoretical model	Not assessed	Exercise motivation inventory-2
Gobbi et al., (2012)	Brazil	359	60+	49.3	Socio-ecological	Barrier to PA practice questionnaire	Not assessed
Kolt et al., (2004)	Australia	840	55-93	~60	No behavioural theory	Not assessed	Participation motivation questionnaire
Kowal & Fortier, (2007)	Canada	509	39-68	60	Ecological approach	Questionnaire based on previous literature	Not assessed

Supplementary Material 3

Qualitative data extracted and characteristics of studies containing qualitative data

Author	Country	Behavioural Theory	Age Range (years)	Sample Size	Barriers 50-64 years	Motivators 50-64 years	Barriers 65-70 years	Motivators 65-70 years
Alizadeh & Salehi, (2015)	Iran	No behaviour theory	60-97	60	Lack of motivation, physical health limitation, and customs.	No motivators reported in this age group.	Environmental safety, weather too hot.	No motivators reported in this age group.
Arnautovska et al., (2017)	Australia	Integrate Behaviour Change Model	67-87	20	No barriers reported in this age group.	No motivators reported in this age group.	Negative states (pain, fear and safety), past experience, perceptions about old age, time constraints, safety of footpaths, weather.	For well-being, obtain a health benefit, for fun, for pride, doctor, media, aesthetics of place.
Ball et al., (2006)	Australia	Ecological	18-65	56	Lack of time management, conditions at work, lack of motivation.	No motivators reported in this age group.	No barriers reported in this age group.	No motivators reported in this age group.
Belon et al., (2016)	Canada	ANGELO framework	25-64	35	Dirtiness, acts of vandalism, ugliness, safety, car	Social relationships, community organisation,	No barriers reported in this age group.	No motivators reported in this age group.

					dependence.	walking the dog.		
Bopp et al., (2007)	USA	No behaviour theory		44	Lack of time due to work, family and church. Lack of willpower or desire. Lack of knowledge on how to exercise, fatigue due to work schedule, health condition. Exercise groups not constant, recreation places too crowded, neighbourhood safety concerns, no age appropriate programs.	Need to take care of body, health benefits of exercise, improve mental health, sense of vitality, being determined and have willpower.	No barriers reported in this age group.	No motivators reported in this age group.
Bruner & Chad, (2013)	Canada	No behaviour theory	15-55+	19	Cold weather, personal safety (primarily from animals),	No motivators reported in this age group.	No barriers reported in this age group.	No motivators reported in this age group.

					laziness.			
Buman et al., (2010)	USA	No behaviour theory	50-75	26	History of traumatic experience, fear of injury, cost, time management.	Health concerns, prevention of disease, literature, witness other people getting sick, enjoyment.	No barriers reported in this age group.	No motivators reported in this age group.
Caperchione et al., (2012)	Australia	No behaviour theory	43.8 (±10.84)	30	Time, work, child care, family needs, laziness, lack of motivation.	Better health, weight management, disease prevention, set example to children, fear becoming ill.	No barriers reported in this age group.	No motivators reported in this age group.
Casey et al., (2011)	Australia	Socio-ecological model	25-64	25	Injuries and disabilities, pain, previous experience when younger, bad experience with health system, culture in social area, program with lack of	No motivators reported in this age group.	No barriers reported in this age group.	No motivators reported in this age group.

					exclusivity for specific age groups, affordability of facilities, quality of facilities.			
							High socio-economic class: lack of social support and everyday obstacles, or barriers faced during their daily life, weather, social isolation and health conditions Low socio-economic class women: cost, everyday obstacles, and household chores, lack of time, lack of safety.	
Cassou et al., (2011)	Brazil	No behaviour theory	69.9 (±6.9)	25	No barriers reported in this age group.	No motivators reported in this age group.		No motivators reported in this age group.
Ceria-Ulep et al., (2011)	Hawaii	No behaviour	65-87	47	No barriers reported in this	No motivators reported in this	Competing role responsibilities	No motivators reported in this

		theory			age group.	age group.	(family obligations, job constraints, community responsibilities), church religious, family obligations. Feeling tired and weak, lack of motivation and laziness, ageing.	age group.
Chatfield, (2015)	USA	No behaviour theory	53-70	16	Injuries, temporal illness, lack of time, weather extremes.	Mental health, manage daily stress, improve quality of life, Women: manage weight.	No barriers reported in this age group.	Change in motivation over time, competition motivation, comparison with others.
Chaudhury et al., (2012)	Canada	No behaviour theory	65-92	34	No barriers reported in this age group.	No motivators reported in this age group.	Uneven sidewalks or tripping hazard, busy street with high traffic volume, traffic congestion, feeling unsafe, crime, accessibility.	No motivators reported in this age group.
Chrisman et al., (2015)	USA	Social-cognitive	27-75	19	Narrow sidewalks, lack of resources	Children.	No barriers reported in this	No motivators reported in this

		Theory			and facilities, busy streets, difficulty cycling, having to pay to use facilities, children, and crime.		age group.	age group.
Cousins, (2003)	USA	Social-cognitive Theory	55-92	41	No barriers reported in this age group.	No motivators reported in this age group.	Negative beliefs.	Social encouragement from family, friends, physicians, past mastery, habitual activity.
Das et al., (2016)	USA	Health Belief Model	51.3 (±11.6)	12	Perception of physical activity, work demands, believing they were physical active enough at work, family obligation, pain from PA ailments.	No motivators reported in this age group.	No barriers reported in this age group.	No motivators reported in this age group.
Evans, (2011)	USA	Kleinman's EMS	40-60	20	Physical condition, too tired, laziness	No motivators reported in this	No barriers reported in this	No motivators reported in this

					and lack of motivation, no partner, other obligations (work, family, social), lack of time, rain or excessive heat.	age group.	age group.	age group.
Gallagher et al., (2010)	USA	No behaviour theory	61-85	21	No barriers reported in this age group.	No motivators reported in this age group.	Rundown neighbourhood, presence of people, safety of area, traffic and sidewalks, bad weather, fear of falling.	Presence of people.
George et al., (2014)	Australia	No behaviour theory	34-64	15	Time and work commitments, family schedule, lack of available facilities, ageing and decline in physical condition, lack of motivation and laziness, not having something to	Maintaining and improve health, increase longevity, participate with physical activity with their children, be good role model to children, stress reliever, change of scenery, guilt of not being	No barriers reported in this age group.	No motivators reported in this age group.

					strive.	physical activity, belong to a social group, appearance and fitness, succeed in their sport of activity.		
Gonzales & Keller, (2004)	USA	Ecological	48-65	10	Family comes first, friends, laziness, fatigue, pain.	Family friends.	No barriers reported in this age group.	No motivators reported in this age group. Health benefits, maintain physical functioning, psychological well-being, enjoyment, satisfaction, opportunity to socialise, friendly competition.
Gray et al., (2016)	Northern Ireland	Self-determination Theory and Self-efficacy Theory	50+	28	Lack of recreational facilities, admission funds, lack of transport.	Low socio-economic class: health conditions, safety at night, knowledge on PA guidelines, weather.	High socio-economic class: time constraints, family commitments.	High socio-economic class: rehabilitation from health conditions, physical activity presented on the

								media.
Guell et al., (2016)	UK	No behaviour theory	65-80	32	No barriers reported in this age group	No motivators reported in this age group	Physical limitation, ill health, lack of companions or friends.	Lifelong activities, social support, family, friends, neighbours, social norms.
Guell et al., (2018)	UK	No behaviour theory	65-80	40	No barriers reported in this age group.	No motivators reported in this age group.	Health problems, no motivation, retirement as a busy period in life.	Life history of participating if physical activity, health benefits, being part of a team, “busy ethic”.
Harley et al., (2014)	USA	Success Model Approach and Positive Deviance	26-65	14	Financial, physical strain, history of sedentary relapse.	Getting or staying healthy, disease, weight loss, mental health, social connections and gratification.	No barriers reported in this age group.	No motivators reported in this age group.
Henwood et al., (2011)	Australia	No behaviour theory	65-81	18	No barriers reported in this age group.	No motivators reported in this age group.	No barriers reported in this age group.	Health benefits (physical and mental), group environment, social challenge to improve.

Jancey et al., (2009)	Australia	No behaviour theory	64-74	16	No barriers reported in this age group.	No motivators reported in this age group.	General aches and pains, loss of flexibility, lack of balance, confidence, and shortness of breath. Poor body image and incumbent weather. Social obstruction to exercise as they are labelled as old.	No motivators reported in this age group.
Kalavar et al., (2004)	USA	Self-efficacy Theory	66-79	10	No barriers reported in this age group.	No motivators reported in this age group.	Health problems, fear of injury, bad weather, inadequate environment (sidewalk, potholes), not something you do at old age, no past experience of exercise, not wanting to start something new, laziness, no motivation, not part of culture in	Peers, doctor, self-motivation.

							US / daily routine, lack of time due to family.	
Kamphuis et al.,(2007)	Netherland	Theory of Planned Behaviour	29-81	38	Bad weather and winter. Low socio-economic class: poor neighbourhood aesthetics, feeling unsafe, cost for taking part in exercise.	High socio-economic class: walking the dog.	No barriers reported in this age group.	No motivators reported in this age group.
Keegan et al., (2016)	UK	No behaviour theory	31-57	14	No barriers reported in this age group.	Role models, awareness by others, activity together, moral support, 'me time', being part of group, physical environment.	No barriers reported in this age group.	No motivators reported in this age group.
Kegler et al., (2013)	USA	Positive Deviance and Socio-ecological	40-70	29	No barriers reported in this age group.	Managing health problems, advice from health care	No barriers reported in this age group.	No motivators reported in this age group.

						providers, manage or lose weight, health benefits of exercise, good feeling, and thinking of family, care for family members, and care for oneself. Pets, military background.		
Kolt et al., (2006)	New Zealand	Self-efficacy Theory	60-79	24	No barriers reported in this age group.	No motivators reported in this age group.	Lack of education about benefits and how to carry physical activity, lack of motivation, perceptions about safe walkways, weather, facilities, transport, extended family over protection of older generation, health and medical conditions, health professional not	No motivators reported in this age group.

							instructed to exercise, embarrassed to exercise in front of other people, reluctance to participate with other cultural groups.	
Kosteli et al., (2016)	UK	Social-cognitive Theory	54-79	37	Lack of time either perceived or real due to family or personal reasons, pain, lack of motivation to start exercising, less structure post-retirement, social comparison with younger generation, inclement weather, lack of exercise partner,	Prescription by physician, necessity to stay health, enjoyment, mood regulation, relaxation, social life, previous physical active at work, gives purpose in life.	No barriers reported in this age group.	No motivators reported in this age group.

					financial.			
Leavy & Aberg, (2010)	Dublin and Stockholm	No behaviour theory	65-89	30	No barriers reported in this age group.	No motivators reported in this age group.	Environment being a barrier (heavy traffic, lack of green areas), joint pain and breathlessness.	Transition from working to retired life, self motivation feel good factor, being part of a club.
Mathews et al., (2016)	India	Socio-ecological model	25-60	28	Lack of time, motivation and interest, physical discomfort caused by walking.	Pleasant walking routes and sight of other walkers.	No barriers reported in this age group.	No motivators reported in this age group.
McArthur et al., (2014)	Canada	No behaviour theory	40-62	53	Poor mood, poor experience, self-sabotage, lack of structure, other demands, have necessary equipment ready, fatigue, self-sacrifice.	Positive feeling, enjoyment, doing something different, meaningful, perceived health benefits.	No barriers reported in this age group.	No motivators reported in this age group.
Melillo et al., (2001)	USA	No behaviour theory	59-76	17	No barriers reported in this	No motivators reported in this	Fear and a feeling of	No motivators reported in this

					age group.	age group.	inappropriateness in their culture, negative effect on their health, shame at doing exercise,	age group.
Miller & Brown, (2017)	USA	No behaviour theory	65-72	10	Health conditions, expensive, uncontrollable life events.	Health benefits, feel good factor, enjoyment, to remove solitude, part of routine, support from friends and family.	No barriers reported in this age group.	No motivators reported in this age group.
Mitra et al., (2015)	Canada	No behaviour theory	65-74	14	No barriers reported in this age group	No motivators reported in this age group.	Personal safety, health condition, climate condition, sidewalks, wide roads, traffic, health benefits, previous life experience, health related problems.	No motivators reported in this age group.
Mohamed et al., (2014)	USA	No behaviour theory	28-65	17	Exercise not a top priority employment is.	Role models within their community,	No barriers reported in this	No motivators reported in this

					Embarrassment to exercise, cultural barriers as in Somalia they as not use to exercising, cost of facilities and transport.	sense of competition.	age group.	age group.
Mosquera et al., (2012)	Colombia	No behaviour theory	20-64	44	Lack of bike paths, physical infrastructure poor, past negative experience, hostile environment to cycle, cultural barrier to bicycle use, women perceived less safe than men, cultural barrier are they as not though at a young age.	No motivators reported in this age group.	No barriers reported in this age group.	No motivators reported in this age group.
Paluck et al., (2006)	Canada	No behaviour theory	18-65+	44	Lack of facilities and resources, cold	No motivators reported in this	No barriers reported in this	No motivators reported in this

					weather, distance to facilities, no formed groups.	age group.	age group.	age group.
Rathanaswami et al., (2016)	Canada	No behaviour theory	37-55	8	Family responsibility, upbringing, clothing, cost, language, societal issues. Lack of time, busy schedule. Male: irregular hours. Female: work commitments, family commitments.	No motivators reported in this age group.	Feeling guilty that they are taking time for themselves that does not benefit the whole family, location, immediate living surrounding and husband.	No motivators reported in this age group.
Romeike et al., (2016)	Netherland	Theory of Planned Behaviour and Self-Regulating Theories	20-65	36	Lack of motivation, mood, tiredness.	No motivators reported in this age group.	No barriers reported in this age group.	No motivators reported in this age group.
Royce et al., (2003)	USA	Socio-	22-75	53	Perception that	No motivators	No barriers	No motivators

	ecological	physical activity is inconvenient and not compatible with busy lifestyle. Tired at end of day, past experience with walking when younger, narrow view of what physical activity is, community values, gender difference in activity selection, lack of social support, no community value on competition and sport not participation, reliance on car transport, urban area makes	reported in this age group.	reported in this age group.	reported in this age group.

					travelling long and distant, lack of available resources, poor walk ability, facilities opening hours, safety.			
Sebastião et al., (2015)	USA	Socio-ecological Perspective	60-80	20	No barriers reported in this age group.	No motivators reported in this age group.	Health issues, fixed income limited access to exercise, role as caregivers, neighbourhood unsafe.	Friends and family, social centre and church.
Sebastião et al., (2014)	USA	Socio-ecological	65-75	7	No barriers reported in this age group.	No motivators reported in this age group.	Chronic health problems, bad weather, lack of safety, lack of infra-structure.	Friends, encouragement.
Steltenpohl et al., (2018)	USA	Socio-emotional Selectivity Theory	18-26 and 59+	78	No barriers reported in this age group.	Encouragement from others, family and friends support, meet people.	No barriers reported in this age group.	No motivators reported in this age group.
Van Dyck et al., (2017)	Belgium	No behaviour theory	62.9 (±1.9)	37	Physical barriers were	No motivators reported in this	No barriers reported in this	No motivators reported in this

					paving stones, tram rails (mainly dangerous for cyclists), wrongly parked cars, poorly maintained sidewalks, and dangerous crossings. Accessibility to sports centres, bad weather, no partner to be active with, lack of time, financial issues, no motivation, having too much time – difficult to organise free time, health barrier, insufficient opportunities.	age group.	age group.	age group.
Wertman et al., (2016)	Canada	Health Belief Model and Life Course	40-82	20	Not enough time, expensive.	Health benefits, new experiences,	No barriers reported in this age group.	No motivators reported in this age group.

Theory	reduce isolation, individual practice.